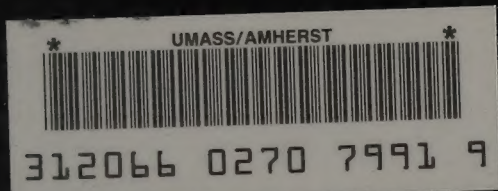
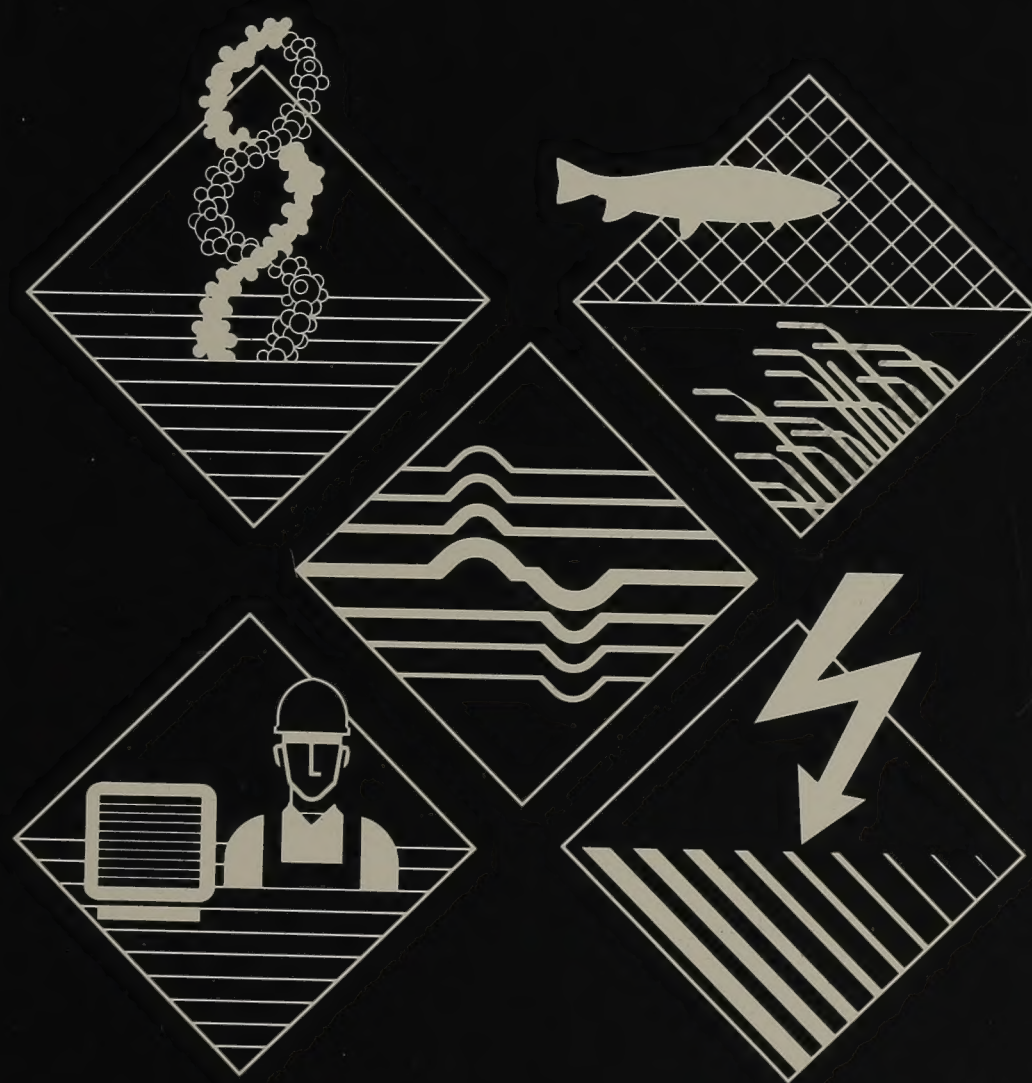


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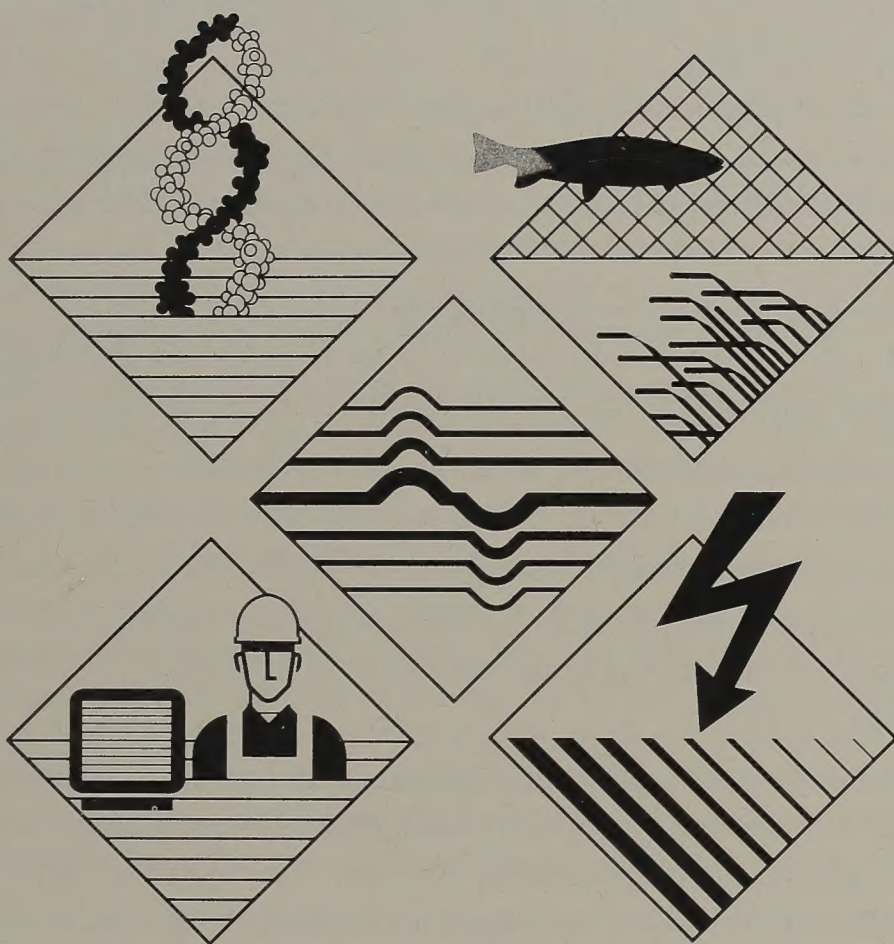


MASSACHUSETTS CENTERS OF EXCELLENCE CORPORATION



The rapid progress true Science now makes occasions my regretting sometimes that I was born so soon. It is impossible to imagine the Height to which may be carried, in a thousand years, the Power of Man over Matter. We may perhaps learn to deprive large Masses of their gravity, and give them absolute Levity for the sake of easy transport. Agriculture may diminish its Labour and double its Produce; all Diseases may, by sure means, be prevented or cured, not even excepting that of Old Age, and our Lives lengthened at pleasure even beyond the antediluvian standard. O that moral Science were in as fair a way of Improvement, that Men would cease to be Wolves to one another, and that Human Beings would at length learn what they now improperly call Humanity.

Benjamin Franklin
1706-1790



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1988-1989 Report

MASSACHUSETTS CENTERS OF EXCELLENCE CORPORATION

The **Massachusetts Centers of Excellence Corporation** (MCEC) was established in 1985 by the Dukakis administration to capitalize on the Commonwealth's greatest strength — the ingenuity, intelligence and skills of its citizens. Its mission is to serve as a catalyst for innovation: to foster new technologies and new applications of existing technologies through a powerful new alliance of business, universities and state government. Historically, Massachusetts has been a home for new ideas. It was the birthplace of the American Revolution, a leader of the U.S. industrial revolution and most recently an international pioneer in the development of the computer industry. Today Massachusetts is putting together the public, private and academic forces to encourage the creation of the next generation of high technology.

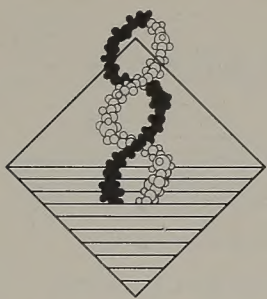
The legislation that created MCEC identified four technologies — biotechnology, marine science, polymer science and photovoltaics — as initial areas for concentration. In 1987 the Center for Applied Technology was added to assist small and mid-sized manufacturing firms in applying appropriate technology to the workplace.

To guide MCEC, outstanding leaders from industry, academia and government are generously donating their time and expertise to serve on the Corporation Board and the technology boards. The primary goals adopted by the MCEC Board of Directors are:

- To aspire to the highest standards of excellence in scientific research and industrial applications in specified areas of emerging technologies which hold substantial promise for the future economic growth of the Commonwealth.

- To promote a spirit of cooperation and partnership between academic institutions and private industry in order to speed the transformation of scientific discovery into usable technology.

At the heart of the Centers of Excellence is its partnership grants program. In its first two years of operation MCEC funded over 60 joint industry/education research and development projects selected through a highly competitive process. Through its Center for Applied Technology it has also supported and managed six technical assistance projects. State funding for these projects totalled \$2.49 million which was matched by \$2.72 million from MCEC grantees. In addition, these projects have leveraged over \$35 million from private sector and federal sources.



BIOTECHNOLOGY CENTER OF EXCELLENCE

Advances in biotechnology are rapidly contributing to what will be one of the most significant growth industries of the 1990s. Massachusetts is well-positioned to become an international leader in this field with the unparalleled excellence of its academic and research institutions and with one of the highest concentrations of industrial biotechnology companies in the world.

The Commonwealth's reputation in advanced science and technology is reinforced by the flow of new ideas from outstanding public and private universities, such as Harvard, Massachusetts Institute of Technology, the University of Massachusetts, Tufts University and Boston University. In addition, Massachusetts enjoys some of the most highly regarded hospitals and research institutions, including Massachusetts General Hospital, Dana-Farber Cancer Institute, University of Massachusetts Medical School, Whitehead Institute for Biomedical Research and Tufts-New England Medical Center. The state is also home to the National Science Foundation-sponsored M.I.T. Biotechnology Process Engineering Center.

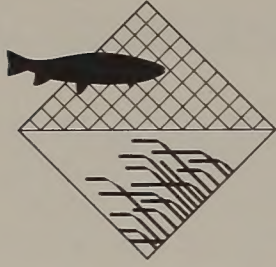
Over 80 biotechnology companies and an increasing number of biotechnology-related businesses are based in Massachusetts. Employing over 5,000 people, these companies range in size from small three-person enterprises to larger firms of several hundred employees. Their activities include the development of human proteins for pharmaceutical use, the manufacture of new diagnostic products and the development of microbial pesticides and new plant varieties.

MCEC is committed to facilitating the broad application of biological research advances and has invested in projects ranging from agricultural integrated pest management (IPM) projects to the creation of an Innovation Center in the Massachusetts Biotechnology Research Park in Worcester.

Cranberries constitute the single most important agricultural crop in Massachusetts with annual revenues of \$110 million. A root and berry rot is affecting a substantial portion of the potential crop, thereby reducing harvests and, in turn, income and employment. Bans on chemical fungicides are increasing due to their negative effects on human health and the environment. MCEC has awarded matching grants of \$82,714 to UMass Amherst and BioTechnica International, Inc. of Cambridge to develop a natural microbial fungicide to control *phytophthora* root infection. Field tests of bacterial treatment are showing statistically meaningful results which will lead to the development and scale-up of a commercially viable product.

Plant parasitic nematodes cause an estimated half billion dollars in U.S. crop damage each year. Another MCEC-funded IPM project with the University of Massachusetts and BioTechnica International, Inc. (\$75,000 from MCEC matched by \$103,000) seeks to replace toxic chemical nematicides that are increasingly being banned by EPA with naturally occurring organisms which interfere with a nematode's food-finding apparatus. Researchers are isolating and testing microorganisms from nematode-suppressive soils, with field trials to follow.

With MCEC funding of \$625,000 matched by an equal amount from the Worcester-based Massachusetts Biotechnology Research Institute (MBRI) and the Worcester Business Development Corporation, an Innovation Center dedicated to capturing the economic benefits of biotechnology research has been successfully launched. One of MBRI's first projects was the formation of Commonwealth Bioventures, Inc. (CBI), a venture capital firm that provides new biotechnology companies with financial and managerial assistance. Within a year CBI has raised over \$10 million in private capital which it has invested to create six new biotechnology companies specializing in such areas as: the production of transgenic animals for improved nutrition and human pharmaceuticals; the development of novel genetically engineered carbohydrate polymers for human therapeutics; and the development of bio-pesticides for medical and industrial uses. This project has been instrumental in helping MBRI become a significant stimulus for employment growth in central Massachusetts and has contributed to the Commonwealth's national and international leadership in biotechnology.



MARINE SCIENCE CENTER OF EXCELLENCE

MCEC is funding marine science projects which offer significant promise for job creation and expansion of economic activity in coastal Massachusetts, especially in the southeastern region with its concentration of marine companies. The Marine Science Board identified water quality, marine electronics and marine resources as areas of particular importance.

The pollution of Massachusetts' coastal waters has had adverse effects on the economy of the state and the health of its citizens. Although Massachusetts' regulatory agencies are working to limit the flow of sewage and septage into the coastal environment, the problem continues to grow. MCEC provided \$80,000 matched by \$110,000 for a solar aquatic waste water treatment project, a revolutionary method of treating waste water.

Ocean Arks International of Falmouth, a non-profit research entity, in partnership with Ecological Engineering Associates, Inc. (EEA), has successfully created and tested a natural systems-based technology for treating septage and sewage. It removes both nutrients and toxic substances from waste water by channeling the wastes through a series of tanks exposed to sunlight and containing a carefully designed progression of bacteria, algae, snails and fish. An MCEC-supported pilot project in Harwich on Cape Cod led to private investment of \$5 million, representing a 100 to 1 leveraging factor after one year of operation. The project is now being scaled up in Harwich to treat the town's septage and in Marion to treat boat wastes. John Todd of Ocean Arks, the developer of this technology, received a 1989 EPA Merit Award for his innovation and has filed for 102 patents. The extraordinary level of interest expressed in this technology in the national and international press bodes well for the continued growth of EEA and for the success of the project.

Massachusetts is a leading competitor - along with California, Japan and France - in a race towards a huge new market in navigation products as a result of the creation of a new U.S. satellite system known as the Global Positioning System (GPS). The situation is analogous to the early development of computers in the 1940's when Massachusetts won a lion's share of the jobs and related economic benefits because of the critical mass of research and entrepreneurship at the Massachusetts Institute of Technology. According to the investment firm of Frost and Sullivan, "The market possibilities of the Global Positioning System open up the entire navigation market to a new generation of receivers. Total market value will be billions of dollars."

Today's critical mass in GPS navigation is being developed by MCEC at Southeastern Massachusetts University in partnership with area companies, such as Datamarine International, Sipican and Datasonics. MCEC is the only state entity supporting research and development in this vital area. Its two year investment of \$313,000 has been matched by over \$395,000 in private sector and institutional support. The partnership team is building a low-cost prototype receiver which will be tested in the summer of 1990. Their aim is to have a competitive product on the market by 1991 that will cost about \$2000 and will be available for fishing and recreational boating interests.

MCEC has worked with Massachusetts' leading universities and research institutions as well as with corporations manufacturing marine products to obtain federal funding for research and development activities. MCEC is the recipient of a major federal grant to study the competitiveness of the U.S. marine electronics industry, a significant commercial sector in Massachusetts. MCEC has also created a federally-funded, multi-state alliance to carry out research in aquaculture and was instrumental in winning designation for Southeastern Massachusetts University as one of four national aquaculture research centers. In addition, MCEC is encouraging the development of marine biotechnology industries in Massachusetts and is seeking federal support for this effort.



POLYMER SCIENCE CENTER OF EXCELLENCE

MCEC has funded projects which the Polymer Science Board selected for their potential to strengthen the polymer research capabilities of the state's universities and extensive polymer industry. Areas of particular importance include: environmental considerations involving polymeric materials, polymer processing and fabrication technology and advanced materials.

Electroplating companies, long a significant industry in southeastern Massachusetts, are threatened by the difficulty of economically reducing their effluent levels. The efficient removal of toxic heavy metals from waste water on a practical scale is a complex task because the existing techniques are expensive and require a relatively high level of skill to operate.

Cape Cod Research, Inc. of Buzzards Bay and the Massachusetts Maritime Academy are developing an efficient, cost-effective procedure for the removal of heavy metals by using low-cost biopolymer beads. In its first phase the project demonstrated the laboratory feasibility of using different biopolymers and their selectivity to various metal ions under differing effluent streams. A local plating company is working with Cape Cod Research to determine the usefulness of the developed technology using the firm's existing water treatment facility. The project also has the potential to be adapted to treating waste from pulp and paper mills and from contaminated soil. Because of its promise, the project has received \$91,000 from MCEC over two years which has been matched by \$175,473 from the partners.

Injection molding is a critical sector of the Massachusetts plastics/polymer industry. The ultimate goal of the injection molding process is to produce zero defect parts at the highest possible manufacturing rate. In order to accomplish this goal it is necessary to identify defective parts as rapidly as possible and to take action to correct the defects, thus reducing the need for constant parts inspection.

MCEC is supporting a project with the University of Lowell and Scientific Systems, Inc. of Cambridge that applies several recently developed techniques in intelligent control, statistical modeling and pattern recognition in an effort to solve this problem. The intent is to determine all significant correlations between observed process variables used for machine control and statistical process control used for specific types of defects that would result in part rejection. Using a software package for fault detection that has been refined by inputs generated from this project, researchers will build an on-line, quality monitoring machine for an injection molding process. To date, the partners have matched MCEC's funding of \$86,000 with \$194,000.

The Polymer Board is also supporting a new initiative to create an Institute for Plastics Innovation (IPI) at the University of Lowell. The IPI is envisioned as a state-of-the-art plastics manufacturing facility that will focus on design (CAD/CAM), materials selection, manufacturing components and related equipment. The IPI project is seen as an important extension of the polymer processing expertise at the University of Lowell and one which will create a unique facility within the United States.



CENTER FOR APPLIED TECHNOLOGY

The Center for Applied Technology (CAT) addresses two fundamental problem areas facing small and medium-sized manufacturers. Smaller firms often cannot find or afford the technical expertise needed for defining, evaluating and then solving their technology or manufacturing-related problems. CAT provides direct technical assistance to firms on planning and implementing change in production technology including: recommendations on updating or acquiring new equipment; analysis of work organization and skill development to achieve maximum productivity and skill utilization; and financial and management analysis of the impact of technical change and cost/benefit to firms.

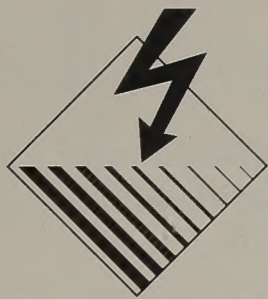
A unique aspect of the Center for Applied Technology's assistance is the requirement that workers be involved in the planning and implementation of any changes, thus reassuring workers that change will not jeopardize their jobs. The costs of the technical assistance are shared equally by CAT and the company.

CAT has provided assistance to a universal joint company with 50 employees for an extensive reorganization of production methods and equipment, financial analysis and planning. Prior to CAT assistance, the company was unable to modernize because the cost of recommended equipment was too high. CAT's analysis showed that improvements could be made immediately with only a modest equipment investment. The costs of manufacture have decreased about 15% while the quality has improved. The firm now anticipates doubling its production capacity and increasing employment by about 15%. Because of reductions in costs and its plans to add new capacity, the firm is now negotiating a marketing agreement with a midwest firm that will double the demand for its product. Total cost of this project for CAT and the company was \$8,000.

A second problem that CAT addresses is that new technologies are frequently not designed with the needs of smaller manufacturers in mind. Often they are expensive, lack flexibility, are designed for large-scale applications and sometimes displace workers. CAT sponsors industry-wide technology development and transfer research projects with the measurable goals of effective application and reasonable cost of new technologies to smaller firms and the preservation of employment. Academic institutions join with Massachusetts manufacturers, labor and other government agencies to address critical technology needs of specific industrial sectors.

A project with a group of die cast part suppliers and a large parts buyer working with University of Massachusetts, Amherst faculty is refining a software program for increased manufacturing efficiency in the design of cast parts. CAT has funded the project with \$74,715 which the partners have matched with \$87,235. There are 25 Massachusetts shops currently involved in some die casting work. These firms are important suppliers to large firms in the Commonwealth. In this project company engineers and skilled workers are joining with researchers to identify bottlenecks and design problems in die casting. The die casting shops will use the program to design parts with lower manufacturing costs. Once the project is completed, the results will be disseminated through training classes for die casting workers and corporate buyers.

CAT has also developed a cost-estimating software package called **Jiffy Quote** for use in job shops and for short-run production lines. Highly flexible, easy to use and low-cost, **Jiffy Quote** eliminates time-wasting, routine, manual calculations and gives a high degree of accuracy in quotes. Based on preliminary testing in job shops, it can reduce the time to produce a cost estimate by 60 to 70 percent.



MASSACHUSETTS PHOTOVOLTAIC CENTER

From July 1988 through June 1989 the Massachusetts Photovoltaic Center has continued to pursue strategies that enhance the diffusion of photovoltaics into the world marketplace. These strategies include: identifying market opportunities to enlarge sales potential for the photovoltaic (PV) industry; the development of an infrastructure to support PV diffusion in Massachusetts, the United States and around the world; and analysis of the physical, economic and regulatory environment in which PVs must compete with mature energy technologies.

The evolution of photovoltaics in the marketplace is being matched by the range of programs and services offered by the four divisions of the Massachusetts Photovoltaic Center. Each division creates a synergy of effort that enhances the basic work of infrastructure education and development, market assistance and utility encouragement. Efforts involve both short-term strategies, such as the Market Information Service, and long-term strategies, such as infrastructure development and technology transfer.

The Demonstration Division provides technology information transfer and educational outreach for the PV Center. Its activities are directed at developing an infrastructure of decision makers and technicians capable of choosing photovoltaics for its appropriate uses. Programs include the International Visitors Programs, Workshops and Seminars, the Information Dissemination Program and the Resource Library.

The Export Assistance Division focuses on overcoming the barriers to developing a global PV market. Because of the competitive intensity of foreign markets, there is a critical need for advanced information on trade leads and marketing opportunities for U.S. companies. The two programs under this Division are the Photovoltaic Market Information Service (PV-MIS) and the Renewable Energy Data Service.

The efforts of the Technology Services Division are directed at expanding technical knowledge and the user experience base for stand-alone applications. The University of Lowell's PV Program provides evaluation and technical services through its Systems Evaluation Projects, the International Training Program and Coordination Activities.

The Financial Services Division is devoted to overcoming the perception that photovoltaics is too costly for general use. From an economic perspective, one of the largest drawbacks to photovoltaics is the initial capital cost. The benefits of photovoltaics include long lifetime, no fuel costs and minimal maintenance costs. By comparison, the major competitors of photovoltaic power exhibit economic characteristics of low initial costs, but significant operating costs as well as shorter life spans. In the course of its activities, the PV Center has observed a disparity of advantage accorded conventional power technologies to the detriment of renewable energy resources. External costs of conventional energy production, such as pollution and risk, have negative value but are usually not considered in cost analyses. The Financial Division of the PV Center completed a study in the fall of 1988 outlining the various social costs and environmental impacts of conventional electric power production.

Among many special activities and programs throughout the year, one deserves special mention. In July 1988 in collaboration with the United Nations, the PV Center coordinated and directed a conference for twenty international decision makers and policy planners from Latin America and the Caribbean Basin. The Photovoltaic Systems Workshop was sponsored and prepared by a unique collaboration which included multilateral development organizations, state and federal government agencies and the photovoltaic industry.

CONCLUSION

By providing critical financial support for applied research and development and technical assistance projects, the Massachusetts Centers of Excellence Corporation fulfills a unique niche in the array of economic development support services provided by Massachusetts quasi-public and state government agencies. It also joins other states which have taken the initiative in developing programs to encourage technological innovation. At the present time forty-five states are investing over \$500 million annually in a variety of activities designed to strengthen their own and, thereby, the nation's industrial base.

State leaders see firsthand the closed plants and unemployed workers that are the result of America's declining competitiveness in world markets. Out of necessity they have acted to save their local economies. The diversity of U.S. industry and the need to maintain flexibility in attempting to develop and test new policies argue for state involvement. State governments understand local needs and resources; state leaders are well acquainted with their industry and academic leaders; and, most important, state governments have the ability to experiment, fulfilling their mission as "laboratories" for the development of innovative policies.

The Massachusetts Centers of Excellence Corporation is indeed such a laboratory where industry, education and government work together to find new ways to keep the Massachusetts economy competitive nationally and abroad.



BIOTECHNOLOGY

Support for the Massachusetts Biotechnology Research Institute Innovation Center

Massachusetts Biotechnology Research Institute, Worcester
Worcester Business Development Corporation, Worcester

Biotechnology Film Series: "Of the Earth: Agriculture and the New Biology"; "A Delicate Balance: Understanding Human Health through Biotechnology"; "Connections: Animals, People & Biotechnology"

University of Massachusetts, Amherst
Monsanto, St. Louis, Missouri/Springfield, Massachusetts
Worcester Memorial Hospital, Worcester
Tufts University School of Veterinary Medicine, North Grafton

Pollen Biotechnology as a Method of Increasing the Cold Tolerance in the Commercial Tomato

University of Massachusetts, Amherst
The Bars, Deerfield

A Diagnostic Test for the Presence of Certain Oncogenes in Tumor Samples Using Non-Isotopically-labelled DNA Probes

University of Massachusetts Medical School, Worcester
Applied bioTechnology, Inc., Cambridge

Development of a Natural Microbial Fungicide for Use in Integrated Pest Man- agement of Cranberries

University of Massachusetts, Amherst's Cranberry Experiment Station, East
Wareham
BioTechnica International, Cambridge

Non-Chemical Control of Plant Parasitic Nematodes through Blocking of Food-Finding Behavior

University of Massachusetts, Amherst
BioTechnica International, Cambridge

Development of Implantable Polymers for Controlled Release of Veterinary Vaccines

Massachusetts Institute of Technology, Cambridge
TSI Mason Research Institute, Worcester

Use of a Direct Drug Delivery System in the Treatment of Bovine Mastitis

Tufts University School of Veterinary Medicine, North Grafton
Veterinary Medicine Delivery Systems, Inc., Newton

Biotechnology and the AIDS Challenge in Massachusetts: A Symposium Report

Massachusetts Department of Public Health
Massachusetts Biotechnology Council
Massachusetts Biotechnology Research Institute
University of Massachusetts Medical Center

Biotechnology Advances in Understanding and Treating Cancer

Massachusetts Department of Public Health
Massachusetts Biotechnology Council
Massachusetts Biotechnology Research Institute
Massachusetts General Hospital Cancer Center

Shared Equipment and Facilities

Massachusetts Biotechnology Research Institute, Worcester
Worcester Business Development Corporation, Worcester

Development of an Integrated Biological Management Program for Crown Rot of Asparagus, Using Disease Free Clonal Plantlets Inoculated with an Avirulent Isolate of *Fusarium Oxysporum*

University of Massachusetts, Amherst
Nourse Farms, Inc., South Deerfield

Immunoassay for Pesticides Using Novel Adjuvants for Antibody Production

East Acres Biologicals, Southbridge
University of Massachusetts Medical School, Worcester

Synthesis and Biological Evaluation of Novel Diagnostic and Therapeutic Drugs for Magnetic Resonance Imaging (MRI) and Nuclear Medicine

University of Massachusetts Medical School, Worcester
Worcester Polytechnic Institute, Worcester
Viomedics, Inc., Worcester



MARINE SCIENCE

A Rapid, Sensitive Assay for Paralytic Shellfish Poison

Woods Hole Oceanographic Institution, Woods Hole
Associates of Cape Cod, Falmouth

NAVSTAR/GPS - Development of Skills, Technology and Concepts for Design

Southeastern Massachusetts University, N. Dartmouth
Datamarine International, Inc., Pocasset

Implementation of Underwater Acoustic Simulator Code

Southeastern Massachusetts University, N. Dartmouth
Sippican, Inc., Marion

Develop a Low-Cost Compact ARGOS Satellite Transmitter

Woods Hole Oceanographic Institution, Woods Hole
Ferranti ORE, Inc., Falmouth

Development of a New Water Pollutant Analyzer Based on a Novel Trace Level Concentrator: "The Dynamic Film Concentrator"

Salem State College, Salem
Millipore Corporation, Milford

Development of High Value Products from Fish Processing Plant Wastes

University of Massachusetts, Amherst
Center for Applied Regional Studies, Amherst
Woods Hole Oceanographic Institution, Woods Hole
New England Fisheries Development Foundation, Boston

Solar Aquatic Waste Water Purification: Nutrient and Toxic Substance Removal from Coastal Sewage Discharges

Ocean Arks International, Falmouth
Ecological Engineering Associates, Woods Hole

A Technology for Producing Texturized Foods That Incorporate Under-Utilized Fish and/or Fish Processing By-Products and Wastes

University of Massachusetts, Amherst
The Gorton Group, Gloucester
U.S. Army Research Development & Engineering Center, Natick
Werner & Pfleiderer Corp., New Jersey

High Data Rate Underwater Acoustic Telemetry Link

Southeastern Massachusetts University, N. Dartmouth
Datasonics, Inc., Cataumet

Characterization of Marine Resources Using Image Processing

Woods Hole Oceanographic Institution, Woods Hole
Marine Imaging Systems, Inc., Woods Hole

Developing a Surimi Industry in Massachusetts

Southeastern Massachusetts University, N. Dartmouth
Forbes & Co., New Bedford

Development of a *Vibrio parahaemolyticus*-specific DNA Probe

University of Massachusetts, Boston
bioTechnica Diagnostics, Inc., Cambridge

A Low-Cost Intelligent Autonomous Underwater Vehicle

Massachusetts Institute of Technology, Cambridge
Sippican, Inc., Marion



POLYMER SCIENCE

Efficiency Improvement Extension Service for Polymer Processing Industry

University of Lowell
Automated Assemblies, Clinton
Dynisco, Inc., Norwood

Development of an Artificial Intelligence System for Injection Molding

University of Lowell
MiTech, Andover

Artificial Intelligence Applied to Injection Mold Design

University of Massachusetts, Amherst
General Electric Plastics, Pittsfield

Massachusetts Mold Analysis Research Consortium

University of Lowell
General Electric, Pittsfield
Monsanto, Springfield
Digital Equipment Corporation, Northboro

Magnetic Absorbents for Waste Water Treatment

Massachusetts Maritime Academy, Buzzards Bay
Cape Cod Research, Buzzards Bay

Defective Part Prediction for Injection Molding

University of Lowell
Scientific Systems, Cambridge
Nypro, Clinton
Dynisco, Norwood

Computer-Aided Project Design for Economical Manufacture

University of Massachusetts, Amherst
Digital Equipment Corp., Shrewsbury

Fiber Optic Switching Using Polymer Nonlinear Optic Materials

University of Lowell
Foster-Miller, Waltham

Novel Polysilanes for Photolithographic Applications

University of Lowell
Digital Equipment Corporation, Andover

Evaluation, Optimization and Implementation of Polymer Recycling Technologies in the Commonwealth of Massachusetts

University of Lowell
New England CRInc, North Billerica

Fiber Formation in Self-Reinforcing Polymer Blends

University of Massachusetts, Amherst
General Electric, Pittsfield

Massachusetts Polymer Degradation Research Group

University of Lowell
Polysar, Leominster
Monsanto, Springfield
U.S. Army Research, Development & Engineering Center, Natick

Institute for Plastics Innovation

University of Lowell
General Electric, Pittsfield
Dynisco, Norwood
Instron, Canton
Dow, Midland, Michigan

**Polymer Science and Engineering Lab at the University of Massachusetts,
Amherst**

University of Massachusetts, Amherst

General Electric, Pittsfield

Monsanto, Springfield

Gas Separation Membranes from Silarylene-Siloxane Polymers

University of Massachusetts, Amherst

Millipore Corporation, Bedford

**Resource Facility for Increasing the Service Life of Critical Parts in Plastics
Processing Machinery by Plasma Nitriding**

Northeastern University

General Electric Plastics, Pittsfield

Demonstration of Sub-Micron Fiber Containing Composites

University of Lowell

Hyperion Catalysis, Lexington

**Optical and Engineering Properties of Molecular Composites Comprising a
Liquid Crystal and Vinyl Polymers**

University of Massachusetts, Amherst

Polaroid, Cambridge

Metal Oxide Ceramics from Organometallic Polymers and Copolymers

University of Massachusetts, Amherst

Norton Company, Northborough

A New Approach to Injection Molding

University of Massachusetts, Amherst

Monsanto, Springfield

Polaroid, Norwood



CENTER FOR APPLIED TECHNOLOGY

TECHNICAL RESEARCH PROJECTS

Massachusetts Manufacturing Resource Center

University of Lowell
Tufts University, Medford
Massachusetts AFL-CIO, Boston
United Shoe Machine, Wilmington
Prime, Framingham

CAD/CAM for the Sheet Metal Industry

Worcester Polytechnic Institute, Worcester
Central Massachusetts Metalworking Partnership, Worcester
Southbridge Metal Works, Inc., Southbridge

A Blueprint for the Foundry Industry

Springfield Technical Community College, Springfield
H.B. Smith Co., Westfield
HBA Cast Products Corporation, Springfield
Komtek, Inc., Worcester
Storms Forge Co., Springfield
Pioneer Valley Central Labor Council AFL-CIO, Springfield
Machine Action Project, Springfield
Westmass Area Development Corporation, Springfield

Product Design for Economic Die Casting

University of Massachusetts, Amherst
Kennedy Die Castings, Inc., Worcester
Digital Equipment Corp., Billerica
Cambridge Tool, Billerica

The Shop Floor Programming Project

University of Lowell
Massachusetts AFL-CIO, Boston
Pelham Machine & Tool Co., Boxborough
Wie Sic Experimental Machine, Lowell
EMCO Maier Corporation, Columbus, Ohio
NEC Information Systems, Boxborough
Nova Biomedical, Waltham

CAD/CAM for Cutting Tools and Artificial Intelligence for Grinding

University of Massachusetts, Amherst
Greenfield Tap & Die, Greenfield
Besly Products, Worcester
United Technologies - Heald Division, Worcester
Cincinnati Milacron, Worcester
Pulpdent, Watertown

TECHNICAL ASSISTANCE PROJECTS

Metals Quality Testing

Metropolitan Machine Company, Medfield

Production Process Analysis

Curtis Universal Joint Company, Springfield

Flexible Cell Design

Pneumatic Scale Corporation, North Quincy

Inventory and Materials Control System

Crawford Products Company, West Hanover

Shop Floor Production Control Systems

Morse Tool Company, New Bedford

Cost Estimating Software for Small & Medium-Sized Job Shops (Jiffy Quote)

Developer: Walter Harrington

**STATEMENTS OF REVENUES, EXPENDITURES,
AND CHANGES IN FUND BALANCES
FOR THE YEARS ENDED JUNE 30, 1989 AND 1988**

	1989		1988	
	GENERAL SUPPORT	RESTRICTED FUNDS	GENERAL SUPPORT	RESTRICTED FUNDS
REVENUES:				
Appropriations:				
Commonwealth of Massachusetts	\$650,985	\$2,368,270	\$625,900	\$2,718,855
National Oceanic and Atmospheric Administration		238,494		257,500
Interest income	276,594	1,675	157,446	
Total revenues	<u>927,579</u>	<u>2,608,439</u>	<u>783,346</u>	<u>2,976,355</u>
EXPENDITURES:				
General support	594,973		490,854	
Depreciation and amortization	30,304		14,330	
Grant payments		2,053,347		1,141,902
Other restricted fund expenditures		67,031		21,230
Total expenditures	<u>625,277</u>	<u>2,120,378</u>	<u>505,184</u>	<u>1,163,132</u>
EXCESS OF REVENUES OVER EXPENDITURES ...	302,302	488,061	278,162	1,813,223
INTERFUND TRANSFER ...	(345,000)	345,000		
FUNDS BALANCES, BEGINNING OF YEAR ...	332,368	2,594,600	54,206	781,377
FUNDS BALANCES, END OF YEAR	<u>\$289,670</u>	<u>\$3,427,661</u>	<u>\$332,368</u>	<u>\$2,594,600</u>

FY 1988 and FY 1989 have been fully audited by Deloitte Touche.

BALANCE SHEETS
JUNE 30, 1989 AND 1988

ASSETS	1989	1988
GENERAL SUPPORT:		
Cash and equivalents	\$ 78,489	\$ 243,836
Prepaid expenses and other	40,536	24,836
Property and equipment:		
Office furniture and equipment	92,516	80,224
Leasehold improvements	67,209	63,080
Total	159,725	143,304
Less accumulated depreciation and amortization	(44,635)	(14,331)
Property and equipment - net	115,090	128,973
Restricted cash and equivalents	101,000	
Total general support	335,115	397,645
RESTRICTED FOR GRANTS - Cash and equivalents	3,556,083	2,594,600
TOTAL ASSETS.....	<u>\$3,891,198</u>	<u>\$2,992,245</u>
LIABILITIES AND FUND BALANCES		
GENERAL SUPPORT:		
Accrued liabilities	\$ 15,132	\$ 28,688
Obligation under capital lease	30,313	36,589
Fund balance	289,670	332,368
Total general support	335,115	397,645
RESTRICTED FOR GRANTS:		
Grant payments payable	128,422	
Fund balance	3,427,661	2,594,600
Total restricted for grants	3,556,083	2,594,600
TOTAL LIABILITIES AND FUND BALANCES	<u>\$3,891,198</u>	<u>\$2,992,245</u>

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